DERIVATION OF THE TERRESTRIAL SPHEROID FROM THE RHOMBIC DODECAHEDRON

Two papers have recently been published which tend to again awaken special interest in the theme of the grand plan of the earth. One is the presidential address of Professor B. K. Emerson on the "Tetrahedral Earth and the Zone of the Intercontinental Seas," delivered before the Geological Society of America; and the other is a lecture before the Royal Geographical Society by Dr. J. W. Gregory, on the "Plan of the Earth and Its Causes."

Both papers are an explanation and discussion of the quaint and suggestive conception of the tetrahedral form of the earth as advanced by William Lothian Green, an English merchant of Honolulu, an original thinker of no mean astuteness, who, in his *Vestiges of the Molten Globe*,[1] presents a hypothesis which can be, by no unbiased student, regarded as lying entirely within the fanciful.

Briefly stated, Green's hypothesis is that on the theory of a cooling globe, a noticeably angular or ridged form would result. As the sphere is the solid which contains the maximum volume under a given surface, so the geometrical form having the minimum volume under the same surface is the tetrahedron. Hence, the contracting globe would tend to assume the tetrahedral shape, as one permitting the greatest reduction of bulk with the least amount of change of surface.

Green takes as his fundamental form the hexatetrahedron with curved faces, as most nearly approaching the sphere. In the development of the hemihedral form of the hexatetrahedron the original faces retained give rise to one set of obtusely pointed pyramids; and the extended portions of the faces a second set of pyramids having more acute apices. The former represent the water areas of the globe and the latter the land

[1] Vestiges of the Molten Globe, Pt. I, London, 1875; Pt. II, Honolulu, 1887.

areas. There are then three triangles of water with their bases against a land triangle around the south pole, pointed northward and interlocked with three great southward-pointing land triangles, having their bases against the north polar triangle of water. Thus is explained the plan of the earth as indicated by its grandest geographic features.

The idea of a tetrahedral earth did not first originate with Green, though it was doubtless original with him. Neither is the attempt to reduce the earth to a faceted body unusual. From the time of Élie de Beaumont, more or less intense interest has been taken in the subject.

The distinctly tetrahedral conception has been, as Professor Emerson has noted, discussed by a number of writers. Richard Owen,[1] of New Harmony, Indiana, and brother of Dr. David Dale Owen, compared the form of the earth to the crystal of diamond. Besides Green, already mentioned, Michel-Lévy[2] has lately formulated his tetrahedral idea of the earth. Still more recently Gregory[3] has considered the subject much along the same lines as the writer last mentioned.

In comparing Green s tetrahedron with that projected by Michel Lévy it may be noted that the obtuse pyramids of the former correspond very nearly to the sharp pyramids of the latter.

Now, the main object of the present note is to call attention to the fact that in all of these more recent attempts to reduce the earth to regular geometrical form there is an important suggestion that appears to have escaped notice. This is embodied in a short paper which appeared in the *American Meteorological Journal* for 1888,[4] under the title of the "Probable Derivation of the Terrestrial Spheroid from the Rhombic Dodecahedron." It is by the same Richard Owen who earlier gave expression to many of the facts and fancies connected with the idea of the tetrahedral earth.

[1] Key to the Geology of the Globe, p. 60, 1857.

[2] Bull. Géol. Soc. France, T. XXVI, p. 105, 1898.

[3] Geographical Journal, Vol. XIII, p. 225, 1899.

[4] Am. Meteorological Jour., Vol. V, p. 289, 1888.

The polar axis of the earth is regarded by Owen as extending from the center of one rhombic face to the center of the opposite one. The sharp, four-sided axial angles of the dodecahedron are near the Aleutian Islands, New Zealand, and, on the earth's equator, at Sumatra and Quito; while the remaining two lie in the Alps and south of the Cape of Good Hope. Thus oriented the following propositions are formulated:

1. Centers of rhombs are usually occupied by water or low land;

2. Ridges of rhombs usually give rise to mountains, and river sources; also sometimes to parallel valleys with important rivers;

3. Many of the apices are characterized by vicinity of volcanic groups;

4. Rhombs facing each other have considerable similarity in the distribution of land and water;

5. Daily rotation and annual revolution seem to have determined the configuration of land.

How closely these generalizations accord with facts may be easily tested by reference to any school globe. Why Owen should have oriented the dodecahedron just as he did does not appear. It would seem that in all cases of this kind the starting point which is first selected has much to do with subsequent developments. In Owen's case the depression of the Arctic Ocean offered the schematic rhomb. Then, too, the Mediterranean area required special attention. So important is the last named region that Michel-Lévy, in his plan, was led to make it a point where three polar edges of his tetrahedron should meet.

If there be anything in the idea of a collapsing crust on a shrinking interior, the tendency of the surface toward the assumption of any angular form would find adequate reason in an adjustment which would produce as nearly as possible the least amount of deformation in the lithosphere compared with the amount of change in the bulk of the earth. This geometrical shape is, as already noted, the tetrahedron; but a four-sided figure in which

each face would be of the most general form — that is, with six facets — curved after the manner of the diamond.

But while the natural tendency, in a collapsing shell, may be to assume a form affording the least change of the surface, extraneous conditions might impose slight modifications in other directions. The resultant form might then be a closely similar shape, having the same symmetry. As related to the hexatetrahedron, the rhombic dodecahedron is one of these forms. And Owen's scheme may more nearly correspond with observed facts than any plan based upon the strictly tetrahedral conception.

In any case, we should expect to have the great world ridges follow approximately the geometrical edges of whatever form is selected. In the central portions of the faces we should expect to find, on the whole, marked depressions. If these features are to be regarded as essential criteria, then Owen's scheme appears to offer fewer objections than any yet suggested. In these considerations the hydrosphere may be practically neglected.

The rhombic dodecahedron is a schematic form to which the great features of the earth are capable of even more exact adjustment than that proposed by Owen. If the dodecahedron be oriented so that one of its axes coincides with the earth's axis of rotation, the ends of the other two axes may be made to intersect the earth's equator where the latter passes through Sumatra, the west coast of Africa, the west shore-line of South America, and the Phœnix Islands, in the central Pacific Ocean. There will then be grouped around the north pole of the earth four rhombic faces as follows:

1. North American,
2. European,
3. Asian,
4. Bering.

Around the equator are:

5. Northern Pacific,
6. Atlantic,
7. Indian,
8. Eastern Pacific.

About the south pole are arranged:

9. South American,
10. South African,
11. South Indian,
12. South Pacific.

The great Cordilleran ridges of North America, from near the extremity of South America to the Arctic Ocean lie directly on the edges of the dodecahedral form. The line is marked by a remarkable succession of volcanoes both active and only recently extinct. Greenland lies on another of the polar edges of the northern zone of rhombs. Another remarkable world-ridge passes down on rhombic margins from Franz Joseph land, through Novaya Zemlya, the Urals, the Himalayas, Sumatra and the Sunda Islands, Australia to Tasmania. Between the last named place and the south pole is Wilkes Land and Victoria Land, with the active volcano Erebus near the line.

From Sumatra, northeastward extends the most wonderful line of active volcanoes known on the globe—the line bordering the east coast of Asia. From Japan a north polar edge is continued in the long island of Saghalien, certain chains of northeastern Siberia, and farther north in the Arctic Ocean by the Liakov Islands.

Other mountain ridges and groups of active volcanoes characterize most of the other edges of the dodecahedron, frequently in a very notable way.

The only apparently incongruous element in the scheme is Europe. But this comparatively high land has its antipodal representative rhomb in the deepest south Pacific.

However fanciful the speculations of this kind may be regarded, it is certain that mountain ranges are susceptible of systematic arrangement. Moreover, mountain ranges must be considered as having different taxonomic ranks according to their genetic origin.

We know that the smaller folds of the earth's strata are complex, that little ones may ride, as it were, on larger ones, and that these again may rise out of still greater swells. Structural

mountains may be thus likened to the waves of a tempestuous sea, and, within each province of the mightiest rolls, may be arranged in harmony with their taxonomic relationships.

The master earth ridges may have one origin, and be arrayed —not in sharply defined geometric figures, perhaps—but in accord with definable laws. Within the grand provinces defined by these greatest features, mountain ranges may be determined by wholly different causes—possibly in out-flowing, curved elevations, something after the manner suggested by Suess for Siberia. Parts of these systems may again be modified by still more local causes—being intensified in some places, softened in others.

In the consideration of mountains, as features of the earth's face susceptible of giving expression to its deepest emotions, we have to recognize fully, before we can hope to understand the riddle of their existence, that all do not possess the same taxonomic values.

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